UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

MEMORANDUM

Date: March 17, 2016

Subject: **Abamectin**. Petition for the Establishment of a Permanent Tolerance and Registration for Use on the Caneberry Subgroup 13-07**A**. Summary of Analytical Chemistry and Residue Data.

PC Code: 122804
Decision No.: 478520
Petition No.: 3E8175
Risk Assessment Type: NA
TXR No.: NA
MRID No.: See Below

DP Barcode: D412860
Registration Nos.: 100-898, 100-1154
Regulatory Action: Section 3 Registration
Case No.: NA
CAS No.: 71751-41-2
40 CFR: 180.449

From: Nancy Dodd, Chemist For N. Dodd
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Summary of Submitted Residue Chemistry Studies		
OCSPP 860 Series Guideline	MRID Number	Title
860.1500	49080101	Dorschner, K. (2012) Abamectin: Magnitude of the Residue on Caneberry (Raspberry or Blackberry). Project Number: 06475/OCR, 06475/00/BER01. Unpublished study prepared by Interregional Research Project No. 4, Washington State University and North Carolina State University. 230 p.

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1.0 Executive Summary

The Interregional Research Project No. 4 (IR-4), on behalf of the Agricultural Experiment Stations of CA, SC, AR, NC, WA, and DE, has submitted a petition to propose use of abamectin to control mites on caneberries and to establish a tolerance for the caneberry subgroup 13-07A. The petitioner proposes addition of the use on caneberries to the Agri-Mek® 0.15 EC and Epi-Mek® 0.15 EC labels.

The petitioner has proposed a tolerance for residues of abamectin (avermectin), including its metabolites and degradates, in/on the caneberry subgroup 13-07A at 0.20 ppm. Compliance with the tolerance levels specified is to be determined by measuring only avermectin B_1 [a mixture of avermectins containing greater than or equal to 80% avermectin B_{1a} (5-*O*-demethyl avermectin A_1) and less than or equal to 20% avermectin B_{1b} (5-*O*-demethyl-25-de(1-methylpropyl)-25-(1-methylethyl) avermectin A_1)] and its delta-8,9-isomer.

Tolerances are established under 40 CFR §180.449 for residues of abamectin (avermectin), including its metabolites and degradates, in or on various crop and livestock commodities at levels ranging from 0.005 ppm to 1.0 ppm. Compliance with the tolerance levels is to be determined by measuring only avermectin B_1 [a mixture of avermectins containing greater than or equal to 80% avermectin B_{1a} (5-*O*-demethyl avermectin A_1) and less than or equal to 20% avermectin B_{1b} (5-*O*-demethyl-25-de(1-methylpropyl)-25-(1-methylethyl) avermectin A_1)] and its delta-8,9-isomer.

Agri-Mek® 0.15 EC (EPA Reg. No. 100-898) and Epi-Mek® 0.15 EC (EPA Reg. No. 100-1154) are to be applied to caneberries as broadcast foliar sprays using ground or aerial equipment. Multiple applications can be made with a retreatment interval of 7 days. The maximum application rates are 0.019 lb ai/A/application and 0.056 lb ai/A/season. The preharvest interval is 7 days.

The residue chemistry database is adequate for tolerance assessment and for registration of the two EC formulations of abamectin on the caneberry subgroup 13-07A. Residues of concern in plants are parent (avermectin B_{1a} and B_{1b}) and the 8,9-Z isomers. The field trials reflect the proposed use pattern. The number of field trials and the geographic representation are adequate. An adequate method was used for data collection. Field trial residues in caneberries (raspberries and blackberries) were low but quantifiable as combined residues. Residues in blackberries decline with increasing preharvest intervals (PHIs). Adequate storage stability data are available to support the field trials. No processed commodities or livestock feed items are associated with caneberries. Caneberries are not considered to be rotated.

2.0 Regulatory Recommendations

There are no residue chemistry considerations that would preclude granting the requested registrations and establishing the recommended tolerance for abamectin on the caneberry subgroup 13-07A. The specific tolerance recommendations are discussed in Section 2.2. There are no recommended label modifications.

2.1 Data Deficiencies/Data Needs

There are no data deficiencies.

2.2 Tolerance Considerations

2.2.1 Enforcement Analytical Method

Adequate enforcement methods for abamectin in plant and livestock commodities are available in the Pesticide Analytical Manual, Volume II (PAM II). The methods have been validated for citrus and processed fractions (Method I), ginned cottonseed (Method IA), and bovine tissues and milk (Method II). These methods determine residues in plant and livestock commodities at limits of quantitation (LOQs) of 0.02 ppm for meat and meat byproducts and ≤0.01 ppm for other plant/livestock commodities. The limit of detection (LOD) of the methods for plant and livestock commodities is 0.001 ppm for each analyte, equivalent to 0.002 ppm for two analyte peaks (i.e., avermectin B_{1a} and its delta-8,9-isomer in one peak and avermectin B_{1b} and its delta-8,9-isomer in the other peak).

2.2.2 Recommended Tolerances

The current tolerance expression in 40 CFR §180.449 is consistent with the S. Knizner memo dated 5/27/09.

Table 2.2.2. Tolerance Summary for Abamectin.

Commodity	Established Tolerance (ppm)	IR-4-Proposed Tolerance (ppm)	HED-Recommended Tolerance (ppm)	Comments (*correct commodity definition*)
Caneberry, subgroup 13-07A	none	0.20	0.20	Caneberry subgroup 13-07A

2.2.3 Revisions to Petitioned-For Tolerances

None.

2.2.4 International Harmonization

The tolerance definitions for plants are essentially the same for the US, Codex, and Canada. There are no Codex maximum residue limits (MRLs) for abamectin on caneberries. Canada and the US are concurrently establishing the new tolerance on the caneberry subgroup 13-07A at 0.20 ppm. Therefore, there are no harmonization issues at this time.

2.3 Label Recommendations

None.

3.0 Introduction

Abamectin is an insecticide/miticide used to control mites, leaf miners, and other insects in commercially important crops. Avermectins are macrocyclic lactones produced as natural fermentation products of the soil bacterium *Streptomyces avermitilis*. Abamectin is a mixture of avermectin B_1 [a mixture of avermectins containing greater than or equal to 80% avermectin B_{1a} (5-*O*-demethyl avermectin A_1) and less than or equal to 20% avermectin B_{1b} (5-*O*-demethyl-25-de(1-methylpropyl)-25-(1-methylethyl) avermectin A_1)] and its delta-8,9-isomer. Abamectin has limited plant systemic activity, but does exhibit some translaminar movement. Abamectin acts as an insecticide by interfering with the nervous system of the insect, causing the insect to become paralyzed. Available mechanistic data indicate a neurotoxic mechanism of action, related to interference with GABA-mediated neurotransmission.

3.1 Chemical Identity

Table 3.1. Abamectin Nomenclature

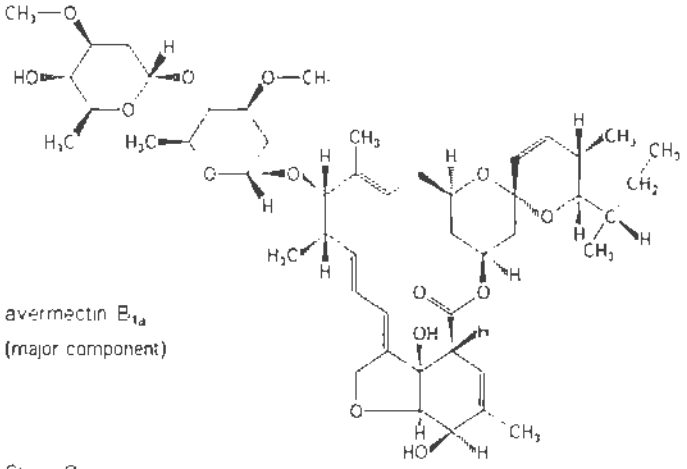
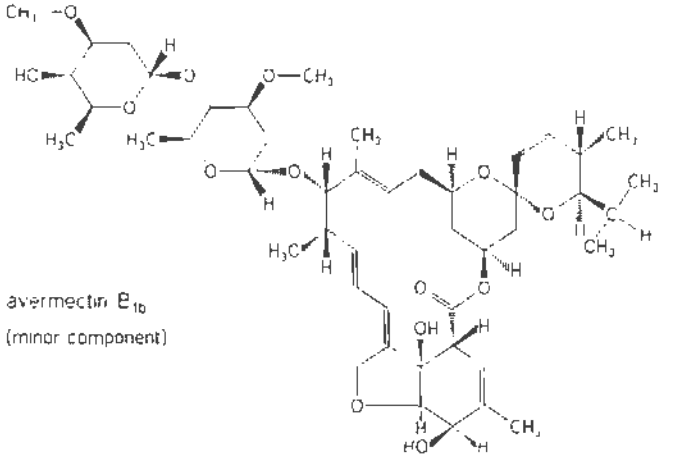
Compound	Chemical Structure
Abamectin	 avermectin B_{1a} (major component)  avermectin B_{1b} (minor component)
Common Names	abamectin, avermectin B_1
Company experimental name	MK-0936
IUPAC name	mixture of (10*E*,14*E*,16*E*)-(1*R*,4*S*,5'*S*,6*S*,6'*R*,8*R*,12*S*,13*S*,20*R*,21*R*,24*S*)-6'-[(*S*)-*sec*-butyl]-21,24-dihydroxy-5',11,13,22-tetramethyl-2-oxo-(3,7,19-

Table 3.1. Abamectin Nomenclature	
	trioxatetracyclo[15.6.1.1^{4,8}.0^{20,24}]pentacosa-10,14,16,22-tetraene)-6-spiro-2'-(5',6'-dihydro-2'*H*-pyran)-12-yl 2,6-dideoxy-4-*O*-(2,6-dideoxy-3-*O*-methyl-α-L-*arabino*-hexopyranosyl)-3-*O*-methyl-α-L-*arabino*-hexopyranoside and (10*E*,14*E*,16*E*)-(1*R*,4*S*,5'*S*,6*S*,6'*R*,8*R*,12*S*,13*S*,20*R*,21*R*,24*S*)-21,22-dihydroxy-6'-isopropyl-5',11,13,22-tetramethyl-2-oxo-(3,7,19-trioxatetracyclo[15.6.1.1^{4,8}.0^{20,24}]pentacosa-10,14,16,22-tetraene)-6-spiro-2'-(5',6'-dihydro-2'*H*-pyran)-12-yl 2,6-dideoxy-4-*O*-(2,6-dideoxy-3-*O*-methyl-α-L-*arabino*-hexopyranosyl)-3-*O*-methyl-α-L-*arabino*-hexopyranoside
CAS name	Avermectin B_1
CAS #	Avermectin B_1 - 71751-41-2; Avermectin B_{1a} - 65195-55-3; Avermectin B_{1b} - 65195-56-4
End-use products/EPs	Agri-Mek® 0.15 EC Miticide Insecticide, EPA Reg. No. 100-898 (contains 0.15 lb ai per gallon); Epi-Mek® 0.15 EC Miticide/Insecticide, EPA Reg. No. 100-1154 (contains 0.15 lb ai per gallon).

3.2 Physical/Chemical Characteristics

Avermectin is a crystalline powder with very low vapor pressure. It has very low water solubility but is soluble in organic solvents. Residues do not readily leach to groundwater due to their affinity for soil particles. Abamectin is stable to abiotic hydrolysis. Refer to Table 3.2 for the table of physical/chemical properties.

TABLE 3.2. Physicochemical Properties of the Technical Grade of Abamectin		
Parameter	Value	Reference
Molecular weight	873.1	MRID 48758002
Melting point range	161.8-169.4 °C (with thermal decomposition)	
pH	8-9 at 25°C	
Density	1.18 x 10^3 kg/m^3 at 22°C	
Water solubility at 25°C	1.21 µg mL at pH 7.57	
Solubility in organic solvents	Acetone 72 g/L Dichloromethane 470 g/L Ethyl acetate 160 g/L Hexane 0.110 g/L Methanol 13 g/L Octanol 83 g/L Toluene 23 g/L	
Vapor pressure at 25°C	<3.7 x 10^{-6} Pa	
Dissociation constant (pK_a)	no dissociation constant in aqueous solution	
Octanol/water partition coefficient, Log P_{ow}	4.4 at pH 7.2	
UV visible absorption spectrum	Absorbance maxima Neutral: 32,549 l mol•cm at 245 nm 18,983 l/mol•cm at 255 nm Acidic: 34,515 l/mol•cm at 245 nm 20,977 l/mol•cm at 255 nm Basic: 29,551 l mol•cm at 245 nm	

3.3 Pesticide Use Pattern/Directions for Use (860.1200)

IR-4 has submitted a petition to add use on the caneberry subgroup13-07A to the Agri-Mek® 0.15 EC (EPA Reg. No. 100-898) and Epi-Mek® 0.15 EC (EPA Reg. No. 100-1154) labels. Both labels are emulsifiable concentrate (EC) formulations containing 0.15 lb ai/gal.

Table 3.3. Summary of Proposed Directions for Use of Abamectin on Caneberry.

Applic. Timing, Type, and Equip.	Formulation [EPA Reg. No.]	Applic. Rate (lb ai/A)	Max. No. Applic. per Season	Max. Seasonal Applic. Rate (lb ai/A)	PHI (days)	Use Directions and Limitations
Caneberry (Crop Subgroup 13-07A) (blackberry, loganberry, raspberry (black and red), wild raspberry and cultivars/varieties, and/or hybrids of these)						
Postemergence; Broadcast foliar spray; Ground or aerial equipment	Agri-Mek® 0.15 EC [100-898] Epi-Mek® 0.15 EC [100-1154]	0.0094-0.019	not stated*	0.056	7	Restricted Use Pesticide Apply when spider mites are first observed and repeat as needed. Do not apply with aircraft in NY state. Apply in a minimum of 10 gals. water by ground or 5 gal water by air. The retreatment interval is 7 days. Do not make more than 2 sequential applications of an abamectin-containing product. A nonionic activator type wetting, spreading, and/or penetrating adjuvant can be used. Do not use binder sticker type adjuvants.

* The maximum number of applications at the maximum rate is 3.

Caneberry samples were analyzed for residues of avermectin B_{1a}, 8,9-Z avermectin B_{1a}, and avermectin B_{1b} using a high performance liquid chromatography (HPLC) method with fluorescence detection based on analytical method M-073.

Conclusions. The Agri-Mek® 0.15 EC Miticide/ Insecticide label (EPA Reg. No. 100-898) and the Epi-Mek® 0.15 EC Miticide/ Insecticide label (EPA Reg. No. 100-1154) are adequate to allow evaluation of the residue data relative to the proposed use.

4.0 Metabolite/Degradate Residue Profile

4.1 Nature of the Residue

4.1.1 Summary of Plant Metabolism (860.1300)

DP Barcode D380523, N. Dodd, 7/18/11

No new plant metabolism data were submitted with this registration request. The qualitative nature of the abamectin residues in the caneberry subgroup13-07A is adequately understood based on metabolism studies on cotton, citrus, and celery (PP#'s 5G3500, 5G3287, and 8F3649, respectively), as well as a report titled "Comparative Degradation of Avermectin B_{1a} in Cotton Leaf, Citrus Fruit, Celery, and *In Vitro*" (PP#9F3703, S. Willett, 12/15/89). The available studies indicate that the metabolism of abamectin in plants results in a complex mixture of residues. The majority of the terminal residue is composed of several unidentified polar degradates. The parent compound, its delta-8,9-isomer, and the alpha 8-OH degradate have been identified in plants, with only the parent and its delta-8,9-isomer each accounting for at least 10% of the total residue. The polar degradates generated on citrus (7-day PHI) and *in vitro* (30 hour sample) have been tested for toxicity (in the developmental toxicity study in CF-1 mice) and were found to be of no toxicological significance at the levels tested (TOX memos 7080 and 7081, W. Dykstra, 3/15/89; PP#8F3592, F. Boyd, 6/21/89; D203373, G. J. Herndon, 3/29/95). As stated in The Pesticide Manual, Eleventh Edition, British Crop Protection Council (1997), abamectin has limited plant systemic activity, but does exhibit some translaminar movement. For the tolerance expression and risk assessment, the residues of concern in these crops are the parent compounds (avermectin B_{1a} and B_{1b}) and their delta-8,9-isomers (also known as 8,9-*Z* avermectin B_{1a} and 8,9-*Z* avermectin B_{1b}).

4.1.2 Summary of Livestock Metabolism (860.1300)

No livestock feed items are associated with use on caneberries (*Table 1 Feedstuffs*, June 2008).

4.1.3 Summary of Confined Rotational Crops (860.1850)

Caneberries are not considered to be rotated (OCSPP 860.1850).

4.1.4. Summary of Metabolites and Degradates

4.2 Comparison of Metaholic Pathways

DP Barcode D380523, N. Dodd, 7/18/11

Metabolism studies on cottonseed, citrus, and celery indicate that the metabolism of abamectin in plants results in a complex mixture of residues. The majority of the terminal residue is composed of several unidentified polar degradates. The parent compound, its delta-8,9-isomer, and the alpha 8-OH degradate have been identified in plants, with only the parent and its delta-8,9-isomer each accounting for at least 10% of the total residue. In citrus, the majority of the residue remained in the peel but a small amount translocated into the pulp. For the tolerance assessment and risk assessment, the residues of concern in these crops are the parent compounds (avermectin B_{1a} and B_{1b}) and their delta-8,9-isomers (also known as 8,9-*Z* isomers).

4.3 Residues of Concern Summary and Rationale

DP Barcode D380523, N. Dodd, 7/18/11
DP Barcode D357192, T. Morton, 1/27/09
DP Barcode D402677, N. Dodd, 12/20/12

Metabolism in Primary Crops: The qualitative nature of abamectin residues in cotton and strawberry is adequately understood based on metabolism studies on cotton, citrus, and celery (PP#'s 5G3500, 5G3287, and 8F3649, respectively), as well as a report titled "Comparative Degradation of Avermectin B_{1a} in Cotton Leaf, Citrus Fruit, Celery, and *In Vitro*" (PP#9F3703, S. Willett, 12/15/89). The available studies on cotton, citrus, and celery indicate that the metabolism of abamectin in plants results in a complex mixture of residues, with the majority of the terminal residue composed of several unidentified polar degradates. The parent compound, its delta-8,9-isomer, and the alpha 8-OH degradate have been identified in plants, with only the parent and its delta-8,9-isomer each accounting for at least 10% of the total residue. The polar degradates generated on citrus [7-day preharvest interval (PHI)] and *in vitro* (30 hour sample) have been tested for toxicity (in the developmental toxicity study in CF-1 mice) and were found to be of no toxicological significance at the levels tested (TOX memos 7080 and 7081, W. Dykstra, 3/15/89; PP#8F3592, F. Boyd, 6/21/89; D203373, G. J. Herndon, 3/29/95). As stated in The Pesticide Manual, Eleventh Edition, British Crop Protection Council (1997), abamectin has limited plant systemic activity, but does exhibit some translaminar movement. For the tolerance expression and risk assessment, the residues of concern in these crops are the parent compounds (avermectin B_{1a} and B_{1b}) and their delta-8,9-isomers (also known as 8,9-*Z* avermectin B_{1a} and 8,9-*Z* avermectin B_{1b}).

Metabolism in Rotational Crops: The qualitative nature of the residue in rotational crops is adequately defined. The confined rotational crop study indicated that avermectin residues accumulated in some rotational crops at levels up to 10-12 ppb. However, the radioactivity was due to polar degradates that were of little toxicological concern as compared to the parent compound avermectin B_1 and/or the delta-8,9-isomer (Memo, P. Mastradone, 4/24/88).

Metabolism in Ruminants: The qualitative nature of abamectin residues in ruminants as a result of application to crops is adequately understood based on a goat metabolism study (PP#7G3468, L. Cheng, 2/11/87; PP#9F3703, S. Willett, 12/15/89). The residues of concern in ruminants for the tolerance expression and risk assessment are the parent compounds (avermectin B_{1a} and B_{1b}) and their delta-8,9-isomers. An additional metabolite (24-hydroxymethyl avermectin B_{1a}) was identified and is potentially of toxicological significance, but was not included in the tolerance expression because of its presence at low levels (PP#8F3592, F. Boyd, 6/21/89; DP#203373, G. J. Herndon, 3/29/95). If the tolerances for residues in meat and milk need to be raised at some future time due to registration of abamectin on additional feed items, the 24-hydroxymethyl metabolite may need to be included in the tolerance expression and appropriate enforcement methods developed.

The qualitative nature of the residue in ruminants from use of the cattle ear tag is adequately understood based on sufficient non-guideline data. The residues of concern are the parent compounds (avermectin B_{1a} and B_{1b}) and their delta-8,9-isomers.

Metabolism in Poultry: No poultry metabolism study has been submitted. Since no significant poultry feed items are associated with the proposed uses, as indicated in *Table 1 Feedstuffs (June 2008)*, no poultry metabolism study is required. (Note: The tolerances for meat and meat byproducts of poultry and swine of 0.02 ppm were established for residues in food handling establishments.)

Metabolism in Rats: Avermectin B_{1a} does not bioaccumulate in rat tissues. Avermectin B_{1a} in rats is metabolized to 24-hydroxy-methyl B_{1a} (i.e., 24-OH-Me-B_{1a}), which accounts for most of the radiolabeled residues.

Residues of concern for the risk assessment and tolerance expression are summarized in Table 4.3 below.

Table 4.3. Summary of Metabolites and Degradates to be included in the Risk Assessment and Tolerance Expression

Matrix		Residues included in Risk Assessment	Residues included in Tolerance Expression
Plants	Primary Crop	Parent (avermectin B_{1a} and B_{1b}) and the delta-8,9-isomers (also known as 8,9-*Z* isomers)	Parent (avermectin B_{1a} and B_{1b}) and the delta-8,9-isomers (also known as 8,9-*Z* isomers)
	Rotational Crop	Parent (avermectin B_{1a} and B_{1b}) and the delta-8,9-isomers (also known as 8,9-*Z* isomers)	Parent (avermectin B_{1a} and B_{1b}) and the delta-8,9-isomers (also known as 8,9-*Z* isomers)**
Livestock	Ruminant*	Parent (avermectin B_{1a} and B_{1b}) and the delta-8,9-isomers (also known as 8,9-*Z* isomers)	Parent (avermectin B_{1a} and B_{1b}) and the delta-8,9-isomers (also known as 8,9-*Z* isomers)
	Poultry	Not applicable	Not applicable
Drinking Water		Parent (avermectin B_{1a} and B_{1b})***	Not applicable

* Residues of concern in ruminants include both use on crops and use in cattle ear tags.
** No rotational crop tolerances have been established.
*** The delta-8,9-isomers (also known as 8,9-*Z* isomers) are not included in the drinking water assessment because they were not identified in the fate studies. The major soil degradate included in the previous assessment (a mixture of an 8-alpha-hydroxy and a ring opened aldehyde derivative) was not included in the current assessment based on an assumption of stability of parent until acceptable environmental fate data are submitted (D380524, G. Orrick, 1/31/11).

5.0 Residue Profile

5.1 Residue Analytical Methods (860.1340)

5.1.1 Data Collection Methods

49080101.der caneberry

Caneberry

Caneberry samples were analyzed for residues of avermectin B_{1a}, 8,9-Z avermectin B_{1a}, and avermectin B_{1b} using an HPLC method with fluorescence detection based on analytical method M-073. The limit quantitation (LOQ) for each analyte is 0.002 ppm, the lowest level of method validation (LLMV). The method was validated prior to sample analysis by spiking control blackberry samples with 0.002-0.1 ppm avermectin B_{1a}, 0.002-0.008 ppm avermectin B_{1b}, and 0.002-0.1 ppm 8,9-Z avermectin B_{1a}. All method validation recoveries were within the acceptable 70-120% range. Adequacy of the method was also confirmed during sample analysis by spiking control blackberry and raspberry samples with 0.002-0.12 ppm avermectin B_{1a}, 0.002-0.01 ppm avermectin B_{1b}, and 0.002-0.12 ppm 8,9-Z avermectin B_{1a}. Four low concurrent recoveries were attributed to spiking errors. The remaining recoveries, with the exception of one concurrent recovery of 68%, were all within the acceptable range of 70-120%. Given that the majority of recoveries were within the acceptable range, the working method based on Method M-073 is adequate for the determination of residues in blackberries and raspberries.

Conclusions. Caneberry samples were analyzed for residues of avermectin B_{1a}, 8,9-Z avermectin B_{1a}, and avermectin B_{1b} using an HPLC method with fluorescence detection based on analytical method M-073. The method has been adequately validated as data collection methods based on acceptable concurrent recovery data. Method M-073 quantitates the sum of avermectin B_{1a} and 8,9-Z avermectin B_{1a} as a single value, with residues of avermectin B_{1b} determined as a separate peak. The LOQ, determined as LLMV, was 0.002 ppm for each analyte in each matrix.

5.1.2 Multi-Residue Methods (860.1360)

DP Barcode D380523, N. Dodd, 7/18/11

The Pestrak database indicates that abamectin and its metabolites are not recovered or not likely to be recovered by FDA multiresidue methods. Therefore, the multiresidue methods cannot be used to determine residues for dietary exposure assessment and cannot be used as the primary enforcement method.

5.1.3 Tolerance Enforcement Methods

DP Barcode D380523, N. Dodd, 7/18/11
DP Barcode D230333, G. Jeffrey Herndon, 1/10/97
DP Barcode D198491, Jerry Stokes, 2/2/94

Adequate enforcement methods for abamectin in plant and livestock commodities are available in the Pesticide Analytical Manual, Volume II (PAM II). The methods have been validated for

citrus and processed fractions (Method I), ginned cottonseed (Method IA), and bovine tissues and milk (Method II). These methods determine residues in plant and livestock commodities at limits of quantitation (LOQs) of 0.02 ppm for meat and meat byproducts and ≤0.01 ppm for other plant/livestock commodities. The limit of detection (LOD) of the methods for plant and livestock commodities is 0.001 ppm for each analyte, equivalent to 0.002 ppm for two analyte peaks (i.e., avermectin B_{1a} and its delta-8,9-isomer in one peak and avermectin B_{1b} and its delta-8,9-isomer in the other peak).

5.1.4 Submittal of Analytical Reference Standards (860.1650)

Analytical reference standards are available at the EPA National Pesticide Standards Repository [Source: e-mail from Gregory Verdin of the Analytical Chemistry Branch/Biological and Economic Analysis Division (ACB/BEAD)].

5.2 Storage Stability (860.1380)

49080101.der

Caneberry samples were stored frozen (≤ -20 °C) from collection to analysis (33.4 months). Adequate storage stability data are available demonstrating that residues of avermectin B_{1a}, avermectin B_{1b}, and 8,9-Z avermectin B_{1a} are stable under frozen storage conditions for 33 months in blackberries.

TABLE 5.2. Summary of Storage Conditions.

Matrix (RAC)	Storage Temperature (°C)	Actual Storage Duration[1]	Interval of Demonstrated Storage Stability (months)
Blackberry and raspberry	≤ -20	1016 days (33.4 months)	Residues of avermectin B_{1a}, avermectin B_{1b} and 8,9-Z avermectin B_{1a} were stable when stored frozen for 33 months in blackberries.

[1] From harvest to extraction. Residues were determined within 5 days of extraction.

Conclusions. The storage stability data are adequate to support the storage intervals and conditions for the caneberry residue samples from the submitted field trials.

5.3 Residue Data

5.3.1 Crop Field Trials (860.1500)

49080101.der (caneberries)

Caneberries:

The Interregional Research Project No. 4 (IR-4) has submitted field trial data for abamectin on blackberries and raspberries. Four field trials were conducted on blackberries in Zones 1 (1 in NY), 2 (1 in NC; 1 in NJ), and 12 (1 in OR). Three field trials were conducted on raspberries in Zones 5A (1 in MI) and Zone 12 (1 trial in WA; 1 in OR). The geographic representation and

number of field trials are adequate. Refer to Appendix A for the geographic distribution table.

At each trial site, abamectin, formulated as an emulsifiable concentrate (Agri-Mek® 0.15EC) was applied to caneberries in three foliar broadcast or directed applications at rates of 19.4 – 23.1 g ai/ha (0.017-0.021 lb ai/A), for total rates of 61.3 – 67.9 g ai/ha (0.055-0.061 lb ai/A). A non-ionic surfactant was included in the spray mixture for all applications. The re-treatment interval (RTI) was 6 – 8 days, and commercially mature blackberries and raspberries were harvested at a PHI of 7 days at all trial sites. Additional samples were harvested at PHIs of 0, 3, and 9 days at one of the blackberry trial sites to determine residue decline behavior. There was one untreated control plot and one treated plot at each trial site.

As shown in Table 5.3.1 below, total combined residues of avermectin B_{1a} + 8,9-*Z* avermectin B_{1a} and avermectin B_{1b} + 8,9-*Z* avermectin B_{1b} in blackberries and raspberries following a total application of 61.3 – 67.9 g ai/ha (0.055-0.061 lb ai/A) ranged from <0.0062 – 0.1215 ppm when samples were harvested at a PHI of 7 days. Total abamectin residues declined with increasing PHI when blackberry samples were harvested at PHIs of 0, 3, 7, and 9 days.

An acceptable method was used for residue quantitation, and adequate storage stability data are available to support sample storage intervals and conditions for all analytes.

TABLE 5.3.1. Summary of Residue Data from Caneberry Field Trials with Abamectin

Commodity	Total Applic. Rate, g ai/ha (lb ai/A)	PHI (days)	Residue Levels[1,2] (ppm)							
			n	Min.	Max.	LAFT[3]	HAFT[3]	Median (STMdR)	Mean (STMR)	Std. Dev.
CANEBERRIES Proposed Use = 0.056 lb ai/acre/season total application rate, 7-day PHI										
Blackberry	62.8 66.1 (0.056-0.059)	7	4	<0.0164	0.0632	<0.0171	0.0535	<0.0233	<0.029	0.017
Raspberry	61.3 67.9 (0.055-0.061)	7	3	<0.0062	0.1215	<0.0067	0.1184	0.0084	0.045	0.064
Blackberry and Raspberry	61.3-67.9 (0.055-0.061)	7	7	<0.0062	0.1215	<0.0067	0.1184	<0.0204	<0.0358	0.040

[1] Residues of avermectin B_{1a}, 8,9-Z avermectin B_{1a}, and avermectin B_{1b} were reported.
[2] Except for sample min/max, values reflect per trial averages; n = no. of field trials. For calculation of median, mean, and standard deviation, the LOQ (0.002 ppm for each analyte in each matrix) was used for any results reported as <LOQ.
[3] LAFT = lowest average field trial; HAFT = highest average field trial.

Conclusions. Adequate field trials were submitted for abamectin on caneberries. Seven field trials were conducted on blackberries and raspberries in Zones 1 (1 in NY), 2 (1 in NC; 1 in NJ), 5A (1 in MI), and 12 (2 in OR; 1 in WA). Abamectin, formulated as an emulsifiable concentrate, was applied to caneberries as three foliar broadcast or directed applications at total rates of 61.3 – 67.9 g ai/ha (0.055-0.061 lb ai/A), and a non-ionic surfactant was included in the spray mixture for all applications. Total combined residues of avermectin B_{1a} + 8,9-*Z* avermectin B_{1a} and avermectin B_{1b} in blackberries and raspberries ranged from <0.0062 – 0.1215 ppm when samples were harvested at a PHI of 7 days. Total abamectin residues declined with increasing PHI when blackberry samples were harvested at PHIs of 0, 3, 7, and 9 days.

The studies reflect the proposed use patterns. The number of trials and the geographic representation are adequate. The residue data are adequately supported by the storage stability studies. The analytical methods are adequate for the analysis of the residues of concern. The residue data adequately address the residues of concern.

5.3.2 Field Rotational Crops (860.1900)

Caneberries are not considered to be rotated.

5.3.3 Processed Food and Feed (860.1520)

There are no processed commodities associated with caneberries.

5.3.4 Meat, Milk, Poultry and Eggs (860.1480)

There are no livestock feed items associated with caneberries.

5.3.5. Food Handling (860.1460)

There are no proposed uses that are relevant to this guideline topic.

5.3.6. Water, Fish, and Irrigated Crops (860.1400)

There are no proposed uses that are relevant to this guideline topic.

5.4. Food Residue Profile

The residue chemistry database is adequate for tolerance assessment and for registration of the two EC formulations of abamectin on caneberries.

Crop field trials: The caneberry (blackberry and raspberry) field trials adequately reflect the proposed use pattern. The number of trials and the geographic representation are adequate. Field trial residues were low but quantifiable in caneberries. Residues in blackberries decline with increasing PHI.

Processing Studies: There are no processed commodities associated with caneberries.

Storage Stability: Adequate storage stability data are available to support the field trials.

Meat, Milk, Poultry, and Eggs: There are no livestock feed items associated with caneberries.

Rotational Crops: Caneberries are not considered to be rotated.

6.0 Tolerance Derivation

As shown in Appendix C, the Organization for Economic Cooperation and Development (OECD) tolerance calculation procedures were used for calculating the recommended tolerance

for caneberries. The statistical goal of the tolerance calculation procedures is to produce an MRL proposal in the region of the 95th percentile of the underlying residues distribution.

Caneberry (MRID 49080101)

The dataset used to establish a tolerance for abamectin consisted of field trial data on blackberries and raspberries representing application rates of 0.056 lb ai/A abamectin with a 7-day PHI. The combined dataset of blackberries and raspberries (seven field trials) was used since the representative crop for the caneberry subgroup 13-07A is either blackberry or raspberry. The field trial application rates and PHIs are within 25% of the maximum label application rate and minimum label PHI, respectively. The average residue values used to calculate the tolerance are provided below. Combined residues of avermectin B_{1a}, 8,9-Z avermectin B_{1a}, and avermectin B_{1b} were quantifiable in/on samples from all seven field trials. Using the OECD tolerance calculation procedures, the recommended tolerance is 0.20 ppm for combined residues of avermectin B_{1a}, 8,9-Z avermectin B_{1a}, and avermectin B_{1b} in caneberries.

Appendix A. Field Trial Geographic Distribution

TABLE A. Trial Numbers and Geographical Locations.				
NAFTA Growing Zones	Caneberry			
	Submitted		Requested (DIR98-02)*	Requested by US**
	Blackberry	Raspberry	Raspberry	
1	1	--	--	1R
2	2	--	--	1B
5	--	--	1	1R
5A	--	1	--	
5B	--	--	1	
6				1B
12	1	2	3	3B,3R
Total	**4**	**3**	**5**	**5**

*Since trials were conducted prior to January 2012, trials are required as indicated in DIR98-02. DIR98-02 does not specify trial requirements for blackberries.

** Table 4, OCSPP 860.1500 indicates that 5 trials (on any one blackberry (B) or any one raspberry (R)) should be conducted for the caneberry crop group. The five sites can be chosen from the requested locations for blackberry and raspberry (Table 5, OCSPP 860.1500).

Appendix B. International Residue Limits Table

Abamectin (122804; 9/19/2013)

Summary of US and International Tolerances and Maximum Residue Limits			
Residue Definition:			
US	Canada	Mexico[2]	Codex
40 CFR §180.449: avermectin B_1 [a mixture of avermectins containing greater than or equal to 80% avermectin B_{1a} (5- O -demethyl avermectin A_1) and less than or equal to 20% avermectin B_{1b} (5- O -demethyl-25-de(1-methylpropyl)-25-(1-methylethyl) avermectin A_1)] and its delta-8,9-isomer	avermectin B_1 (a mixture of avermectins containing greater than or equal to 80% avermectin B_{1a} (5-O-demethyl avermectin A_{1a}) and less than or equal to 20% avermectin B_{1b} (5-O-demethyl-25-de(1-methylpropyl)-25-(1-methylethyl) avermectin A_{1a}) and its delta-8,9-isomer)		Plants: sum of avermectin B1a, avermectin B1b, 8,9-Z-avermectin B1a and 8,9-Z-avermectin B1b. Animal commodities: sum of avermectin B1a and 8,9-Z-avermectin B1a.

Commodity[1]	*Tolerance (ppm) /Maximum Residue Limit (mg/kg)*			
	US	Canada	Mexico[2]	Codex
Caneberry subgroup 13-07A	0.20	0.20 (pending)		
Completed: M. Negussie; 9/19/2013				

[1] Includes only commodities of interest for this action. Tolerance values should be the HED recommendations and not those proposed by the applicant.

[2] Mexico adopts US tolerances and/or Codex MRLs for its export purposes.

Appendix C. OECD MRL Calculation Procedure Inputs/Outputs

Blackberry and Raspberry (MRID 49080101)

0.056 lb ai/A; 7-day PHI

Residues (mg/kg)	n
0.0067	1
0.0084	1
0.0171	1
0.0204	1
0.0262	1
0.0535	1
0.1184	1

Abamectin
Blackberry/Raspberry
USA
0.056 lb ai/A; 7-day PHI

Total number of data (n)	7
Percentage of censored data	0%
Number of non-censored data	7
Lowest residue	0.007
Highest residue	0.118
Median residue	0.020
Mean	0.036
Standard deviation (SD)	0.040
Correction factor for censoring (CF)	1.000
Proposed MRL estimate	
- Highest residue	0.118
- Mean + 4 SD	0.194
- CF x 3 Mean	0.107
Unrounded MRL	0.194
Rounded MRL	0.2

High uncertainty of MRL estimate.
[Small dataset]

Primary Evaluator — Date: 5/15/14
Nancy Dodd, Chemist, RAB3/HED

Approved by — Date: 5/15/14
Steve Funk, Senior Chemist, RAB3/HED

Note: This DER was originally prepared by the Pest Management Regulatory Agency (PMRA), Canada. The DER has been reviewed by the Health Effects Division (HED) and revised to reflect current Office of Pesticide Programs (OPP) policies.

STUDY REPORTS:

MRID #49080101. Dorschner, K. (2012) "Abamectin: Magnitude of the Residue on Caneberry (Raspberry or Blackberry)". IR-4 PR No.: 06475. Analytical Laboratory Identification Number 06475.00-BER01. Unpublished study prepared by IR-4 Project, Rutgers, The State University of New Jersey, Princeton, NJ. 230 pages.

EXECUTIVE SUMMARY:

The Interregional Research Project No. 4 (IR-4) has submitted field trial data for abamectin on caneberries. Four trials were conducted on blackberries in Zones 1 (1 in NY), 2 (1 in NC; 1 in NJ), and 12 (1 in OR). Three trials were conducted on raspberries in Zones 5A (1 in MI) and Zone 12 (1 trial in WA; 1 in OR). At each trial site, abamectin, formulated as an emulsifiable concentrate (Agri-Mek® 0.15EC) was applied to caneberries in three foliar broadcast or directed applications at rates of 19.4 – 23.1 g ai/ha (0.017-0.021 lb ai/A), for total rates of 61.3 – 67.9 g ai/ha (0.055-0.061 lb ai/A). A non-ionic surfactant was included in the spray mixture for all applications. The re-treatment interval (RTI) was 6 – 8 days, and commercially mature blackberries and raspberries were harvested at a preharvest interval (PHI) of 7 days at all trial sites. Additional samples were harvested at PHIs of 0, 3, and 9 days at one of the blackberry trial sites to determine residue decline behavior. There was one untreated control plot and one treated plot at each trial site.

Caneberry samples were analyzed for residues of abamectin (*i.e.*, avermectin B_{1a} + avermectin B_{1b} + 8,9-*Z* avermectin B_{1a} + 8,9-Z avermectin B_{1b}) using a working method based on analytical method M-073. The only modification between the reference method and the working method was that a different column and instrument conditions were used. The lowest level of method validation (LLMV) in this study was 0.002 ppm for each analyte; therefore, the limit of quantitation (LOQ) will be set at 0.002 ppm for each analyte. The method was validated prior to sample analysis by spiking control blackberry samples with 0.002-0.1 ppm avermectin B_{1a}, 0.002-0.008 ppm avermectin B_{1b}, and 0.002-0.1 ppm 8,9-Z avermectin B_{1a}. All method validation recoveries were within the acceptable 70-120% range. Adequacy of the method was also confirmed during sample analysis by spiking control blackberry and raspberry samples with 0.002-0.12 ppm avermectin B_{1a}, 0.002-0.01 ppm avermectin B_{1b}, and 0.002-0.12 ppm 8,9-*Z* avermectin B_{1a}. Four low concurrent recoveries were attributed to spiking errors. The remaining recoveries, with the exception of one concurrent recovery of 68%, were all within the acceptable range of 70-120%. Given that the majority of recoveries were within the acceptable range, the

working method based on Method M-073 is adequate for the determination of residues in blackberries and raspberries in this study.

Blackberry and raspberry samples were stored frozen (≤ -20°C) for a maximum of 1016 days (33.4 months) from harvest to residue extraction. Residues were determined within 5 days of extraction. A freezer storage stability study was conducted concurrently with the analytical phase of the field trial study. Control blackberry samples were spiked with avermectin B_{1a}, avermectin B_{1b} and 8,9-Z avermectin B_{1a} at fortification levels ranging from 0.002-0.245 ppm. Stored samples were analyzed after 978, 986, 995 and 1001 days (~33 months) for avermectin B_{1a} and avermectin B_{1b}. Stored samples were analyzed after 999 days (~33 months) for 8,9-Z avermectin B_{1a}. With the exception of one average recovery (126% in avermectin B_{1a} stored frozen for 978 days), all average freezer storage recoveries (corrected for concurrent recovery where applicable) were within the acceptable 70-120% range. These data indicate that residues of these analytes are stable in blackberries when stored frozen for 33 months. Freezer storage stability data for blackberries can be used to support the storage period for raspberries since these crops are in the same crop group. Since raspberry and blackberry trial samples were stored frozen for a maximum of 33.4 months, there are no concerns regarding the stability of residues in this study since it is not anticipated that residues would have degraded significantly for the extra partial month that trial samples were stored frozen.

Total combined residues of avermectin B_{1a} + 8,9-Z avermectin B_{1a} and avermectin B_{1b} + 8,9-Z avermectin B_{1b} in blackberries and raspberries following a total application of 61.3 – 67.9 g ai/ha (0.055-0.061 lb ai/A) ranged from <0.0062 – 0.1215 ppm when samples were harvested at a PHI of 7 days. Total abamectin residues declined with increasing PHI when blackberry samples were harvested at PHIs of 0, 3, 7, and 9 days.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the field trial residue data are classified as scientifically acceptable.

The acceptability of this study for regulatory purposes is addressed in Canada's forthcoming Evaluation Report.

COMPLIANCE:

Signed and dated Good Laboratory Practice (GLP), Quality Assurance and Data Confidentiality statements were provided. This study meets current Good Laboratory Practice Requirements of 40 CFR Part 160, except as noted below:

1. At all field trials, supporting data such as soil characteristics, weather, irrigation, farm equipment maintenance records, cultural practices, site history records and maintenance chemical applications were not collected in adherence to 40 CFR 160 guidelines.
2. The storage freezer used for the MI07 field trial is not solely under the control of IR-4 personnel. No maintenance or repair logs are kept for it; however, it did have a verified

and monitored temperature recording system.

3. Equipment used to weigh samples at the NC05 and NY07 field sites were not maintained in adherence to 40 CFR 160 guidelines.
4. Temperature logs for test substance storage and frozen sample storage were lost at the WA28 field site. Although there is no indication that storage temperatures fell outside an acceptable range, no data is available to support that claim.

The study director indicated that these deviations did not affect the conclusions presented in the report.

A. BACKGROUND INFORMATION

Tolerances are established for the combined residues of avermectin B_1 [a mixture of avermectins containing ≥80% avermectin B_{1a} (5-*O*-demethyl avermectin A_1) and ≤20% avermectin B_{1b} (5-*O*-demethyl-25-de(1-methylpropyl)-25-(1-methylethyl) avermectin A_1)] and its delta-8,9-isomer. Abamectin is a natural fermentation product of the soil bacterium *Streptomyces avermitilis*. Abamectin is an insecticide/miticide used to control mites, leafminers, and other insects in commercially important crops, as a seed protectant against nematodes, and in veterinary medicine for treatment of internal and external parasites and mites.

The chemical structure and nomenclature of abamectin and the physicochemical properties of the technical grade of abamectin are presented in Tables A.1 and A.2.

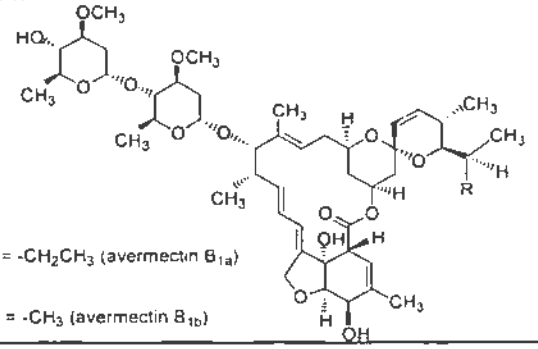
TABLE A.1. Test Compound Nomenclature.	
Compound	Chemical Structure  (i) R = $-CH_2CH_3$ (avermectin B_{1a}) (ii) R = $-CH_3$ (avermectin B_{1b})
Common name	Abamectin; Avermectin B_1
Company experimental name	MK-0936
IUPAC name	avermectin B_1* (i) abamectin B_{1a}: (10*E*,14*E*,16*E*)-(1*R*,4*S*,5'*S*,6*S*,6'*R*,8*R*,12*S*,13*S*,20*R*,21*R*,24*S*)-6'-[(*S*)-*sec*-butyl]-21,24-dihydroxy-5',11,13,22-tetramethyl-2-oxo-3,7,19-trioxatetracyclo-[15.6.1.1^{4,8}.0^{20,24}]pentacosa-10,14,16,22-tetraene-6-spiro-2'-(5',6'-dihydro-2'*H*-pyran)-12-yl 2,6-dideoxy-4-*O*-(2,6-dideoxy-3-*O*-methyl-α-L-*arabino*-hexopyranosyl)-3-*O*-methyl-α-L-*arabino*-hexopyranoside ii) abamectin B_{1b}: (10*E*,14*E*,16*E*)-(1*R*,4*S*,5'*S*,6*S*,6'*R*,8*R*,12*S*,13*S*,20*R*,21*R*,24*S*)-21,24-dihydroxy-6'-isopropyl-5',11,13,22-tetramethyl-2-oxo-(3,7,19-trioxatetracyclo[15.6.1.1^{4,8}.0^{20,24}]pentacosa-10,14,16,22-tetraene)-6-spiro-2'-(5',6'-dihydro-2'*H*-pyran)-12-yl 2,6-dideoxy-4-*O*-(2,6-dideoxy-3-*O*-methyl-α-L-*arabino*-hexopyranosyl)-3-*O*-methyl-α-L-*arabino*-hexopyranoside * including avermectin B_{1a}, avermectin B_{1b} (4:1) and the 8,9-Z isomers
CAS name	Avermectin B_1
CAS #	71751-41-2
End-Use Product/EP	Agri-Mek® 0.15 EC

TABLE A.2. Physicochemical Properties of the Technical Grade Test Compound Abamectin.		
Parameter	Value	Reference
Melting point/range	161.8-169.4°C (with thermal decomposition)	MRID 48758002
pH	8-9 at 25°C	
Density	1.18 x 10^3 kg m^3 at 22 °C	
Water solubility at 25°C	1.21 µg/mL at pH 7.57	
Solubility in organic solvents	Acetone 72 g/L Dichloromethane 470 g/L Ethyl acetate 160 g/L Hexane 0.110 g/L Methanol 13 g/L Octanol 83 g/L Toluene 23 g/L	
Vapor pressure at 25°C	<3.7 x 10^{-9} Pa	
Dissociation constant (pK_a)	no dissociation constant in aqueous solution	
Octanol/water partition coefficient, Log P_{ow}	4.4 at pH 7.2	
UV visible absorption spectrum	Absorbance maxima Neutral: 32,549 l/mol•cm at 245 nm 18,983 l/mol•cm at 255 nm Acidic: 34,515 l/mol•cm at 245 nm 20,977 l/mol•cm at 255 nm Basic: 29,551 l mol•cm at 245 nm	

B. EXPERIMENTAL DESIGN

B.1. Study Site Information

TABLE B.1.1 Trial Site Conditions.				
Trial Identification (City, State/Year)	Soil characteristics			
	Type	% OM*	pH*	CEC* meq/100 g
Trial ID # 06475.00-MI07 Lansing, MI/2000	Coarse loamy sand	2.2	6.1	Not available
Trial ID # 06475.00-NC05 Jackson Springs, NC/2000	Loamy sand	1.8	4.9	Not available
Trial ID # 06475.00-NJ08 Deerfield, NJ/2000	Sandy loam	2.0	5.8	Not available
Trial ID # 06475.00-NY07 Lansing, NY/2000	Silt loam	6.91	7.38	Not available
Trial ID # 06475.00-OR02 Wilsonville, OR/2000	Sandy loam	5.63	6.0	Not available
Trial ID # 06475.00-OR03 Wilsonville, OR/2000	Loam	4.97	5.0	Not available
Trial ID # 06475.00-WA28 Burlington, WA/2000	Silt loam	2.77	5.4	Not available

*These parameters are optional except in cases where their value affects the use pattern for the chemical.

The study report indicated normal weather conditions were experienced at all trial sites, with the following exceptions:

- At the trial conducted in New Jersey (Trial ID # NJ08), above average rainfall was reported for April-July and temperatures were cooler than normal.
- At the trial conducted in New York (Trial ID # NY07), above average rainfall was reported during the trial period.

No phytotoxic effects were reported at any of the field trials. Irrigation (*i.e.*, overhead sprinkler) was used to supplement rainfall at the trials conducted in Oregon (Trial ID#s OR02 and OR03).

TABLE B.1.2. Study Use Pattern.

Location (City, State/Year) Trial ID	EP[1]	Application					Tank Mix/ Adjuvants
		Method/Timing	Volume, L/ha (gal/A)	Rate, g ai/ha (lb ai/A)	RTI[2] (days)	Total Rate, g ai/ha (lb ai/A)	
Trial ID # 06475.00-MI07 Lansing, MI/2000	Agri-Mek 0.15 EC	1. foliar directed/ fruiting	196 (21)	21.0 (0.019)	-	62.9 (0.056)	Latron AG-98 (0.50% v/v)
		2. foliar directed/ fruiting	196 (21)	20.7 (0.018)	7		
		3. foliar directed/ fruiting	206 (22)	21.2 (0.019)	7		
Trial ID # 06475.00-NC05 Jackson Springs, NC/2000	Agri-Mek 0.15 EC	1. foliar directed/ fruiting	140 (15)	20.7 (0.018)	-	62.8 (0.056)	X-77 (6.2% v/v)
		2. foliar directed fruiting	140 (15)	21.0 (0.019)	7		
		3. foliar directed/ fruiting	140 (15)	21.1 (0.019)	8		
Trial ID # 06475.00-NJ08 Deerfield, NJ/2000	Agri-Mek 0.15 EC	1. foliar broadcast/ bloom-fruiting	393 (42)	21.4 (0.019)	-	63.8 (0.057)	Unifilm 707 (0.08% v/v)
		2. foliar broadcast/ fruiting	384 (41)	21.1 (0.019)	7		
		3. foliar broadcast/ fruiting	393 (42)	21.3 (0.019)	8		
Trial ID # 06475.00-NY07 Lansing, NY/2000	Agri-Mek 0.15 EC	1. foliar directed/ fruiting	187 (20)	21.6 (0.019)	-	64.9 (0.058)	Activator 90 (0.51% v/v)
		2. foliar directed/ fruiting	187 (20)	21.6 (0.019)	7		
		3. foliar directed/ fruiting	196 (21)	21.7 (0.019)	6		
Trial ID # 06475.00-OR02 Wilsonville, OR/2000	Agri-Mek 0.15 EC	1. foliar directed/ fruiting	486 (52)	22.0 (0.020)	-	67.9 (0.061)	X-77 (0.06% v/v)
		2. foliar directed/ fruiting	505 (54)	22.8 (0.020)	7		
		3. foliar directed/ fruiting	514 (55)	23.1 (0.021)	8		
Trial ID # 06475.00-OR03 Wilsonville, OR 2000	Agri-Mek 0.15 EC	1. foliar directed/ fruiting	496 (53)	22.0 (0.020)	-	66.1 (0.059)	X-77 (0.06% v/v)
		2. foliar directed/ fruiting	496 (53)	22.2 (0.020)	7		
		3. foliar directed/ fruiting	486 (52)	21.9 (0.020)	7		

TABLE B.1.2. Study Use Pattern.

Location (City, State/Year) Trial ID	EP[1]	Application					Tank Mix/ Adjuvants
		Method/Timing	Volume, L/ha (gal/A)	Rate, g ai/ha (lb ai/A)	RTI[2] (days)	Total Rate, g ai/ha (lb ai/A)	
Trial ID # 06475.00-WA28 Burlington, WA 2000	Agri-Mek 0.15 EC	1. foliar directed/ late bloom	440 (47)	20.7 (0.018)	-	61.3 (0.055)	R-11 (0.25% v/v)
		2. foliar directed/ fruiting	440 (47)	21.2 (0.019)	6		
		3. foliar directed/ mature fruit	412 (44)	19.4 (0.017)	6		

[1]EP – End-use Product
[2] Retreatment Interval

TABLE B.1.3. Trial Numbers and Geographical Locations.

NAFTA Growing Zones	Caneberry			
	Submitted		Requested (DIR98-02)*	Requested by US**
	Blackberry	Raspberry	Raspberry	
1	1	--	--	1R
2	2	--	--	1B
5	--	--	1	1R
5A	--	1	--	
5B	--	--	1	
6				1B
12	1	2	3	3B,3R
Total	**4**	**3**	**5**	**5**

*Since trials were conducted prior to January 2012, trials are required as indicated in DIR98-02. DIR98-02 does not specify trial requirements for blackberries.
** Table 4, OCSPP 860.1500 indicates that 5 trials (on any one blackberry (B) or any one raspberry (R)) should be conducted for the caneberry crop group. The five sites can be chosen from the requested locations for blackberry and raspberry (Table 5, OCSPP 860.1500).

B.2. Sample Handling and Preparation

Mature caneberry samples were harvested randomly by hand from high/low and inside/outside parts of the plants, avoiding the plant on each end row. Samples were harvested first from the untreated plot, and then from the treated plot. The samples (0.23 – 0.91 kg; 0.51-2.0 lb) were placed into bags, and then directly into freezers, or in coolers with ice and then into freezers. The samples were placed in frozen storage within 3 hours of harvest. All samples were then shipped frozen to the analytical laboratory in Beltsville, Maryland where they were received frozen and stored in freezers at temperatures ≤ -16°C until sample preparation. Samples were prepared by chopping with dry ice in a Robot Coupe food chopper.

B.3. Analytical Methodology

Caneberry samples were analyzed for residues of abamectin (*i.e.*, avermectin B_{1a} + avermectin B_{1b} + 8,9-Z avermectin B_{1a} + 8,9-Z avermectin B_{1b}) using a working method based on analytical method M-073. The only modification between the reference method and the working method

was that a different column and instrument conditions were used. Briefly, residues of abamectin were extracted from caneberries by homogenizing with acetonitrile/1.0% phosphoric acid and partitioning three times with hexane. The extract is then cleaned-up on an aminopropyl solid phase extraction (SPE) column and the purified extract is derivatized with trifluoroacetic anhydride. Residues were then determined by high performance liquid chromatography with fluorescence detection (HPLC-FD). The avermectin B_{1a} standard curve was used to calculate the concentration of avermectin B_{1a} + 8,9-Z avermectin B_{1a} and avermectin B_{1b} + 8,9-Z avermectin B_{1b} in/on samples.

NOTE: Avermectin B_{1a} and 8,9-Z-avermectin B_{1a} yield identical products after derivatization (*i.e.*, these analytes form a single HPLC peak at a retention time of ~17.5 minutes). In addition, avermectin B_{1b} and 8,9-Z avermectin B_{1b} also yield identical products after derivatization (*i.e.*, these analytes form a single HPLC peak at a retention time of ~15.7 minutes). The avermectin B_{1a} standard curve was used to quantitate avermectin B_{1b} residues since the response factors for derivatized avermectin B_{1a} and avermectin B_{1b} have been shown to be equivalent.

The calculated LOQs and limits of detection (LODs) for each abamectin analyte are as follows:

Analyte		LOD	LOQ
Avermectin B_{1a}		0.00050 ppm	0.00149 ppm
Avermectin B_{1b}		0.00068 ppm	0.00204 ppm
8,9-Z-avermectin B_{1a}		0.00044 ppm	0.00132 ppm

The LLMV for each of the above three analytes was 0.002 ppm; therefore, the LOQ will be set at 0.002 ppm.

The method was validated prior to sample analysis by spiking control blackberry samples with 0.002, 0.025, 0.050, and 0.1 ppm avermectin B_{1a}, 0.002, 0.004, 0.008 ppm avermectin B_{1b}, and 0.002, 0.05, and 0.1 ppm 8,9-Z avermectin B_{1a} (Table C.1). All method validation recoveries were within the acceptable 70-120% range. Adequacy of the method was also confirmed during sample analysis by spiking control blackberry and raspberry samples with 0.002-0.12 ppm avermectin B_{1a}, 0.002-0.01 ppm avermectin B_{1b}, and 0.002-0.12 ppm 8,9-Z avermectin B_{1a}. There were four low concurrent recoveries attributed to spiking errors. With the exception of one concurrent recovery of 68% (blackberry sample spiked with 0.050 ppm avermectin B_{1a}), the remaining recoveries were all within the acceptable 70-120% range. Given that the majority of recoveries were within the acceptable range, the working method based on Method M-073 is adequate for the determination of residues in this study.

NOTE: Method validation/concurrent recoveries were not conducted using 8,9-Z avermectin B_{1b}. However, the active ingredient abamectin is a mixture of at least 80% avermectin B_{1a} and not more than 20% avermectin B_{1b}. Accordingly, very little 8,9-Z avermectin B_{1b} would be expected on plant samples.

C. RESULTS AND DISCUSSION

Seven field trials were conducted on caneberries in the US in the 2000 growing season. Four trials were conducted on blackberries in Zones 1 (1 in NY), 2 (1 in NC; 1 in NJ), and 12 (1 in OR). Three trials were conducted on raspberries in Zones 5A (1 in MI) and Zone 12 (1 trial in WA; 1 in OR). At each trial site, abamectin, formulated as an emulsifiable concentrate (Agri-Mek® 0.15EC) was applied to caneberries in three foliar broadcast or directed applications at rates of 19.4 – 23.1 g ai/ha (0.017-0.021 lb ai/A), for total rates of 61.3 – 67.9 g ai/ha (0.055-0.061 lb ai/A). The RTI was 6 – 8 days. A non-ionic surfactant was included in the spray mixture for all applications. Commercially mature blackberries and raspberries were harvested at a PHI of 7 days at all trial sites. Additional samples were harvested at PHIs of 0, 3, and 9 days at one of the blackberry trial sites (Trial ID # OR03) to determine residue decline behavior. There was one untreated control plot and one treated plot at each trial site.

Caneberry samples were analyzed for residues of abamectin (*i.e.*, avermectin B_{1a} + avermectin B_{1b} + 8,9-Z avermectin B_{1a} + 8,9-Z avermectin B_{1b}) using a working method based on analytical method M-073. The only modification between the reference method and the working method was that a different column and different instrument conditions were used. The LLMV in this study was 0.002 ppm for each analyte; therefore, the LOQ will be set at 0.002 ppm for each analyte. The method was validated prior to sample analysis by spiking control blackberry samples with 0.002, 0.025, 0.050, and 0.1 ppm avermectin B_{1a}, 0.002, 0.004, 0.008 ppm avermectin B_{1b}, and 0.002, 0.05, and 0.1 ppm 8,9-Z avermectin B_{1a} (Table C.1). All method validation recoveries were within the acceptable 70-120% range. Adequacy of the method was confirmed by spiking control blackberry and raspberry samples with 0.002-0.12 ppm avermectin B_{1a}, 0.002-0.01 ppm avermectin B_{1b}, and 0.002-0.12 ppm 8,9-Z avermectin B_{1a}. Four low concurrent recoveries were attributed to spiking errors. With the exception of one concurrent recovery of 68%, the remaining recoveries were all within the acceptable 70-120% range. Given that the majority of recoveries were within the acceptable range, the working method based on Method M-073 is adequate for the determination of residues in this study. Representative chromatograms were provided for standards, controls, spiked samples, and treated samples. Overall, peaks were well defined and symmetrical in all chromatograms. Detector linearity was demonstrated over a six-point range 0.002 – 0.288 µg/mL for combined avermectin B_{1a} and 8,9-Z avermectin B_{1a} ($R^2 \geq 0.987$) and a six-point range 0.0002 – 0.0233 µg/mL for avermectin B_{1b} ($R^2 \geq 0.894$).

Blackberry and raspberry samples were stored frozen (≤ -20°C) for a maximum of 1016 days (~33.4 months) from harvest to residue extraction. Residues were determined within 5 days of extraction. A freezer storage stability study was conducted concurrently with the analytical phase of the field trial study. Control blackberry samples were spiked with avermectin B_{1a}, avermectin B_{1b} and 8,9-Z avermectin B_{1a} at fortification levels ranging from 0.002 to 0.245 ppm. Stored samples were analyzed after 978, 986, 995 and 1001 days (~33 months) for avermectin B_{1a} and avermectin B_{1b}. Stored samples were analyzed after 999 days (~33 months) for 8,9-Z avermectin B_{1a}. With the exception of one average recovery (126% in avermectin B_{1a} stored frozen for 978 days), all average freezer storage recoveries (corrected for concurrent recovery

where applicable) were within the acceptable 70-120% range (Tables C.2.a, C.2.b). These data indicate that residues of these analytes are stable when stored frozen for 33 months in blackberries. Freezer storage stability data for blackberry can be used to support the storage period for raspberries since these crops are in the same crop group. Since raspberry and blackberry trial samples were stored frozen for a maximum of 33.4 months, there are no concerns regarding the stability of residues in this study since it is not anticipated that residues would have degraded significantly for the extra partial month that trial samples were stored frozen.

Total combined residues of avermectin B_{1a} + 8,9-Z avermectin B_{1a} and avermectin B_{1b} + 8,9-Z avermectin B_{1b} in blackberries and raspberries following a total application of 61.3 – 67.9 g ai/ha (0.055-0.061 lb ai/A) ranged from <0.0062 – 0.1215 ppm when samples were harvested at a PHI of 7 days (Tables C.3 and C.4). Total abamectin residues declined with increasing PHI when blackberry samples were harvested at PHIs of 0, 3, 7, and 9 days.

TABLE C.1. Summary of Method Validation and Concurrent Recoveries of Abamectin from Blackberry and Raspberry.

Matrix	Type of Recovery	Spike level (ppm)	Sample size (n)	Recoveries (%)	Mean ± std dev (%)
Avermectin B_{1a}					
Blackberry	Method Validation	0.002	3	105, 105, 85	98 ± 12
		0.025	3	84, 87, 84	85 ± 2
		0.050	3	87, 90, 84	87 ± 3
		0.1	4	86, 83, 77, 85	83 ± 4
	Concurrent Recovery	0.002	14	85, 85, 85, 105, 85, 105, 105, 105, 85, 85, 105, 85, 105, 105	95 ± 10
		0.025	18	82, 94, 92, 72, 75, 93, 75, 87, 95, 102, 72, 88, 90, 92, 105, 92, 88, 90	88 ± 10
		0.050	9	83, 94, 68, 80, 94, 86[1], 90, 92, 94	87 ± 9
		0.1	8	81, 89, 77, 86, 83, 85, 89, 94	86 ± 5
		0.120	2	88, 87	88
Raspberry	Concurrent Recovery	0.002	6	85, 105, 105, 105, 105, 105	102 ± 8
		0.025	7	85, 92, 88, 92, 87, 92, 110	92 ± 8
		0.050	3	83, 91, 91	88 ± 5
		0.1	2	92, 92	92
		0.120	2	88, 113	100
Avermectin B_{1b}					
Blackberry	Method Validation	0.002	3	85, 90, 85	87 ± 3
		0.004	3	75, 73, 78	75 ± 3
		0.008	4	94, 75, 72, 74	79 ± 10
	Concurrent Recovery	0.002	18	90, 115, 100, 105, 85, 71, 81, 70, 110, 95, 71, 85, 75, 100, 85, 115, 85, 75	90 ± 15
		0.004	9	75, 83, 88, 83, 93, 92[1], 86, 78, 83	85 ± 6

TABLE C.1. Summary of Method Validation and Concurrent Recoveries of Abamectin from Blackberry and Raspberry.

Matrix	Type of Recovery	Spike level (ppm)	Sample size (n)	Recoveries (%)	Mean ± std dev (%)
		0.008	8	81, 94, 70, 83, 75, 83, 88, 89	83 ± 8
		0.01	2	86, 81	84
Raspberry	Concurrent Recovery	0.002	7	80, 80, 80, 90, 90, 105, 120	92 ± 15
		0.004	3	70, 85, 80	78 ± 8
		0.008	2	86, 86	86
		0.01	2	82, 115	98
8,9-Z Avermectin-B_{1a}					
Blackberry	Method Validation	0.002	3	105, 85, 85	92 ± 12
		0.05	3	87, 96, 89	91 ± 5
		0.1	3	87, 97, 89	91 ± 5
	Concurrent Recovery	0.002	13	105, 105, 85, 105, 105, 105, 85, 105, 105, 105, 85, 85, 105	99 ± 9
		0.05	3	89, 42[2], 0[2], 0[2], 108, 105	101 ± 10
		0.1	5	88, 49[2], 81, 78, 88, 97	86 ± 7
		0.12	2	98, 100	99
Raspberry	Concurrent Recovery	0.002	6	105, 105, 105, 105, 105, 105	105 ± 0
		0.05	1	98	98
		0.1	2	99, 92	96
		0.12	2	103, 108	106

[1] Average of duplicate analyses.
[2] Low recovery due to spiking error. Result not included in statistical analyses.

TABLE C.2a. Concurrent Freezer Storage Stability Data for Blackberry.

Matrix	Storage Interval (days)	Spike Level (ppm)	Concurrent Recovery (%) [Average Recovery]	Freezer Storage Recovery (%) [Average Recovery]	Average Corrected Recovery (%)[1]
Avermectin B_{1a}					
Fruit	978	0.06	86[2]	--	--
		0.05	--	135, 117 [126]	126
	986	0.0251	102	--	--
		0.0265	--	111, 75, 94 [93]	93
	995	0.06	90	--	--
		0.05	--	110, 119, 89 [106]	106
	1001	0.245	74	--	--
		0.238	--	80, 84[2] [82]	111
Avermectin B_{1b}					
Fruit	978	0.0048	92[2]	--	--
		0.004	--	144, 117, 84[2] [115]	115
	986	0.002	110, 95 [102]	100, 77, 96 [91]	91

TABLE C.2a. Concurrent Freezer Storage Stability Data for Blackberry.

Matrix	Storage Interval (days)	Spike Level (ppm)	Concurrent Recovery (%) [Average Recovery]	Freezer Storage Recovery (%) [Average Recovery]	Average Corrected Recovery (%)[1]
	995	0.005	86	--	--
		0.004	--	100, 76, 85 [87]	101
	1001	0.02	79	87, 103[2] [95]	120
8,9-Z Avermectin B_{1a}					
Fruit	999	0.050	108	113, 117, 119 [116]	116

[1] Corrected Recovery = (Freezer Storage Recovery/Concurrent Recovery)*100, for concurrent and/or freezer storage recoveries <100%.
[2] Average of duplicate analyses

TABLE C.2b. Summary of Storage Conditions.

Matrix (RAC)	Storage Temperature (°C)	Actual Storage Duration[1]	Interval of Demonstrated Storage Stability (months)
Blackberry and raspberry	≤ -20	1016 days (33.4 months)	Avermectin B_{1a}, avermectin B_{1b} and 8,9-Z avermectin B_{1a} are stable in blackberries stored frozen (≤ -20°C) for ~33 months.

[1] From harvest to extraction. Residues were determined within 5 days of extraction.

TABLE C.3. Residue Data from Crop Field Trials with Abamectin

Trial ID (City, State/Year)	Zone	Crop/ Variety	Commodity or Matrix	Total Rate, g ai/ha (lb ai/A)	PHI (days)	Residues (ppm)		
						Avermectin B_{1a} + 8,9-Z Avermectin B_{1a} [mean]	Avermectin B_{1b} [1] [mean]	Total [mean]
Raspberry								
Trial ID # 06475.00-MI07 Lansing, MI/2000	5A	Raspberry/ Heritage	Fruit	62.9 (0.056)	7	0.0056 0.0071 [0.0064]	<0.002 <0.002 [<0.002]	<0.0076 <0.0091 [<0.0084]
Trial ID # 06475.00-OR02 Wilsonville, OR/2000	12	Raspberry/ Meeker	Fruit	67.9 (0.061)	7	0.0052 0.0042 [0.0047]	<0.002 <0.002 [<0.002]	<0.0072 <0.0062 [0.0067]
Trial ID # 06475.00-WA28 Burlington, WA/2000	12	Raspberry/ Meeker	Fruit	61.3 (0.055)	7	0.1132 0.1074 [0.1103]	0.0083 0.0078 [0.0081]	0.1215 0.1152 [0.1184]
Blackberry								
Trial ID # 06475.00-NC05 Jackson Springs, NC/2000	2	Blackberry/ Shawnee	Fruit	62.8 (0.056)	7	0.0597 0.0413 [0.0505]	0.0035 0.0025 [0.0030]	0.0632 0.0438 [0.0535]
Trial ID # 06475.00-NJ08 Deerfield, NJ/2000	2	Blackberry/ Chester	Fruit	63.8 (0.057)	7	0.0216 0.0151 [0.0184]	<0.002 <0.002 [<0.002]	<0.0236 <0.0171 [<0.0204]
Trial ID # 06475.00-NY07 Lansing, NY/2000	1	Blackberry/ Chester	Fruit	64.9 (0.058)	7	0.0158 0.0144 [0.0151]	<0.002 <0.002 [<0.002]	<0.0178 <0.0164 [<0.0171]
Trial ID # 06475.00-OR03 Wilsonville, OR/2000	12	Blackberry/ Evergreen	Fruit	66.1 (0.059)	0	0.105 0.1157 [0.1104]	0.0071 0.0079 [0.0075]	0.1121 0.1236 [0.1179]
					3	0.0291 0.0378 [0.0335]	<0.002 0.0027 [<0.0024]	<0.0311 0.0405 [0.0359]
					7	0.0245 0.0238 [0.0242]	<0.002 <0.002 [<0.002]	<0.0265 <0.0258 [<0.0262]
					9	0.0073 0.0102 [0.0088]	<0.002 <0.002 [<0.002]	<0.0093 <0.0122 [<0.0108]

[1] The study only reports residues of avermectin B_{1b}. Analytical method M-073 is incapable of distinguishing between avermectin B_{1b} and 8,9-Z avermectin B_{1b} since they yield identical products after derivatization (*i.e.*, these analytes form a single HPLC peak). Therefore, the results for avermectin B_{1b} in this study also include residues of 8,9-Z avermectin B_{1b}.

TABLE C.4. Summary of Residue Data from Crop Field Trials with Abamectin										
Commodity	Total Applic. Rate, g ai/ha (lb ai/A)	PHI (days)	Residue Levels (ppm)							
			n	Min.	Max.	LAFT*	HAFT*	Median (STMdR)	Mean (STMR)	Std. Dev.
Total Residues of Abamectin (*i.e.* Avermectin B_{1a} + 8,9-Z Avermectin B_{1a} and Avermectin B_{1b} + 8,9-Z Avermectin B_{1b})										
Blackberry	62.8 – 66.1 (0.056-0.059)	7	8[1]	<0.0164	0.0632	--	--	<0.0247	<0.029	0.016
			4[2]	--	--	<0.0171	0.0535	<0.0233	<0.029	0.017
Raspberry	61.3 – 67.9 (0.055-0.061)	7	6[1]	<0.0062	0.1215	--	--	<0.0084	<0.0444	0.057
			3[2]	--	--	<0.0067	0.1184	0.0084	0.045	0.064
Blackberry and Raspberry	61.3-67.9 (0.055-0.061)	7	14[1]	<0.0062	0.1215	--	--	<0.0207	<0.0358	0.038
			7[2]	--	--	<0.0067	0.1184	<0.0204	<0.0358	0.040

* LAFT = Lowest Average Field Trial; HAFT = Highest Average Field Trial.
[1] Statistical Calculations Based on Total Number of Samples
[2] Statistical Calculations Based on Average Field Trial Values

D. CONCLUSION

The supervised crop field trials for abamectin in/on caneberries are considered scientifically valid. Seven field trials were conducted on blackberries and raspberries in Zones 1 (1 in NY), 2 (1 in NC; 1 in NJ), 5A (1 in MI), and 12 (2 in OR; 1 in WA).

Abamectin, formulated as an emulsifiable concentrate, was applied to caneberries as three foliar broadcast or directed applications at total rates of 61.3 – 67.9 g ai/ha (0.055-0.061 lb ai/A), and a non-ionic surfactant was included in the spray mixture for all applications. Total combined residues of avermectin B_{1a} + 8,9-Z avermectin B_{1a} and avermectin B_{1b} + 8,9-Z avermectin B_{1b} in blackberries and raspberries ranged from <0.0062 – 0.1215 ppm when samples were harvested at a PHI of 7 days. Total abamectin residues declined with increasing PHI when blackberry samples were harvested at PHIs of 0, 3, 7, and 9 days.

E. REFERENCES

Arenas, R.V. (1996) M-073: HPLC-Fluorescence Method for the Quantitation of Avermectin B_1 and 8,9-Z Avermectin B_1 in/on Fruits and Vegetables. Unpublished study prepared by Merck Research Laboratories, Three Bridges, NJ. 24 pages.

F. DOCUMENT TRACKING

RDI: N. Dodd (5/15/14); RAB3 ChemTeam (5/15/14); S. Funk (5/15/14)
Petition Number: 3E8175
DP Barcode: 412860
PC Code: 122804